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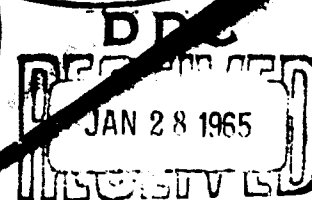
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Mechanical
PROPERTIES DATA CENTER

TECHNICAL INFORMATION SYSTEMS
SUTTONS BAY, MICHIGAN

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Further Use Of
RETRIEVED DATA

**ANSWERS FROM MILLIONS OF TEST MEASUREMENTS
IN AUTOMATED STORAGE FOR YOUR USE IN . . .**



Material Selection

Design Optimizing Analyses

Test Program Design

Evaluation of Test Variables

Evaluation of Manufacturing Variables

Reliability Studies

Researching Materials Behaviour

FOR DATA, CONTACT:

THE MECHANICAL PROPERTIES DATA CENTER

c/o TECHNICAL INFORMATION SYSTEMS

SUTTONS BAY MICHIGAN — PHONE 616-271-3911

MECHANICAL PROPERTIES DATA CENTER

SUTTONS BAY, MICHIGAN 49682

AN AIR FORCE MATERIALS INFORMATION CENTER

AREA CODE 616 BR 1-3911

August 1964

Subject: Inventory Report 620
AISI H-13-Hot Work Die Steel

This is the third of a series of reports designed to acquaint the aerospace industries with the content and use of the Mechanical Properties Data Center. Since the total system content of over 2,000,000 data points is too large to conveniently display under one cover, this report deals only with data in storage as of this date on the subject material. Subsequent reports will present the storage content for other materials.

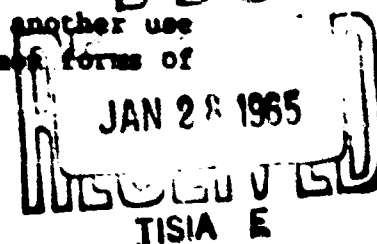
The Mechanical Properties Data Center is designed to retrieve data meeting specific requirements of the requester thereby relieving him of manually searching through referenced reports for data satisfying his needs. In keeping with this purpose, the Data Center does not as a rule disseminate material properties on a routine basis as this would only add to the volume of technical literature competing for the attention of the technical community. Instead, these reports are distributed merely to acquaint potential users with the amount and type of data available to them on request. It should be borne in mind that because of the large daily increase in the storage content, the inventory counts given in this report are representative of the minimum quantity of data available from the system files.

The inventory presented below is in a very brief form. Actually there are hundreds of ways to arrange and classify the data. When a question is received, appropriate data is retrieved, arranged and presented to meet the requesters specific need.

Summary Inventory - AISI H-13, Hot Work Die Steel

<u>Test Type</u>	<u>Total Tests</u>	<u>Current Number of Tests in Storage File Per Temperature</u>		
		<u>Room</u>	<u>Elevated</u>	<u>Cryogenic</u>
Tension	354	312	42	-
Compression	25	10	15	-
Shear	25	10	15	-
Bearing	50	20	30	-
Creep and/or Stress Rupture	98	59	39	-
Impact and/or Fracture Toughness	262	71	143	48

As an example of output from the system the following has been presented in a typical handbook style. This type of presentation, although not one that is used frequently, is shown only for the purpose of demonstrating another use of the system. Tabulated as well as graphical displays are common forms of output.



MECHANICAL PROPERTIES DATA CENTER

Inventory Report 620

August 1964

General

AISI type H-13, a 5% chromium hot-work die steel, is used for aircraft and missile components wherein the ability to realize high strength levels by air hardening and tempering is advantageous.

Alternate Designations

Some of the more common alternate designations are Cr-Mo-V, hot form V, Potomac M, VDC Viscount 20 and Viscount 44.

Forms Available

H-13 is available in sheet, bar, forgings, drill and welding rods.

Composition

The composition range (% by weight) of H-13 is given in the table below:

	<u>Percent by Wt.</u>	
	<u>Min.</u>	<u>Max.</u>
Chromium	5.00	5.75
Molybdenum	.83	1.50
Vanadium	.90	1.20
Silicon	.84	1.10
Carbon	.35	.43
Manganese	.25	.45
Sulfur	----	.03
Phosphorus	----	.03

Heat Treatment

Annealing - Pack in cast iron chips or sand to which a small amount of carbonaceous material has been added. Heat slowly to 1550-1650° F. Hold at temperature one hour for each inch of smallest container thickness.

Hardening - Satisfactory results are obtained when material is quenched in air or oil from 1800-1950° F. The use of a salt bath or controlled atmosphere furnace is desirable to minimize decarburization. For die casting dies a temperature of 1825-1850° F followed by an air quench is recommended. Pre-heating is done in two stages, first at 1200-1250° F and then at 1600° F, making sure that work is heated through thoroughly at each pre-heating temperature.

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Heat Treatment - continued

- Tempering - Up to 1000°F there is little change in hardness. Average hot work applications require draws at 900-1200°F. Due consideration should be given to the size of sections involved and a double draw is suggested.
- Nitriding - Good results can be expected when material is nitrided in either gas or nitriding salt. It is often desirable to nitride die casting dies to improve die life and to prevent sticking of the casting to the die cavity.

Fabrication

- Formability - Heat slowly to about 1500°F and more rapidly to the forging range of 1900-2100°F. Do not work below 1500-1600°F. Cool slowly in insulating material or furnace after forging. Annealing soon after forging is recommended.
- Machining - Machined in the annealed condition. This alloy has a machinability rating of 70 (Based on a scale which rates straight carbon tool steel at 100).
- Welding -
Welding annealed dies. Preheat to 1000°F if possible, or to as high a temperature up to 1000°F as is practical. Keep the temperature of the die above 600°F by reheating until the welding is completed. Retard cooling by either furnace cooling or by covering the welded area with asbestos, lime, ashes, or other insulating material. Follow with a full pack anneal at 1550°F. After finishing to size, the die can be heat treated in a conventional manner.
- Welding hardened dies. Preheat the dies to as high a temperature as possible but preferably in the range of 800-1000°F. Furnace preheating is considered safest, but torch heating is widely practiced. Weld with air hardened rod using shielded arc equipment or if desired, non-critical areas can be welded with stainless rod and electric arc equipment. After welding, place in furnace at

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Fabrication - continued

preheat temperature and cool slowly to room temperature. Reheat to just below the tempering temperature and air cool again to stress relieve.

Special Considerations

Cross-rolling this material exhibits no directional properties other than slight reduction in elongation.

This material has excellent change characteristics. It will normally grow slightly when heat treated.

Detrimental results may be obtained if material is heat treated using protective coatings which contain copper.

Mechanical Properties

Typical mechanical properties are presented in the following graphic displays.

<u>Figure</u>	<u>Display</u>
1	Tensile Properties vs Test Temperature. (Annealed condition)
2	Compression Properties vs Test Temperature. (Annealed condition)
3	Shear Properties vs Test Temperature. (Annealed condition)
4	Bearing Strength vs Test Temperature. (Annealed condition)
5	Creep Deformation vs Time-tested at 600°F and indicated stresses. (Preheat at 1300°F, solution treat at 1900°F, double temper at 1025°F)
6	Fatigue Strength at Room Temperature and 1000°F. (Hardened at 1850°F, double tempered at 1100°F)

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FIGURE 1

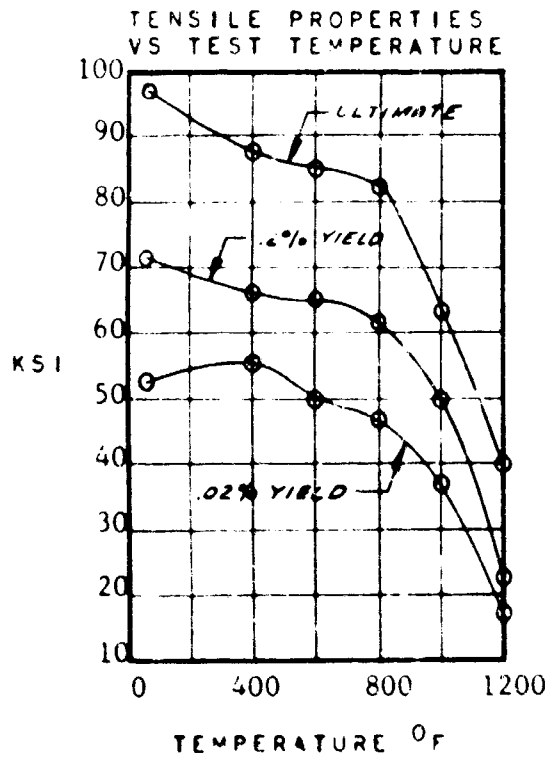


FIGURE 2

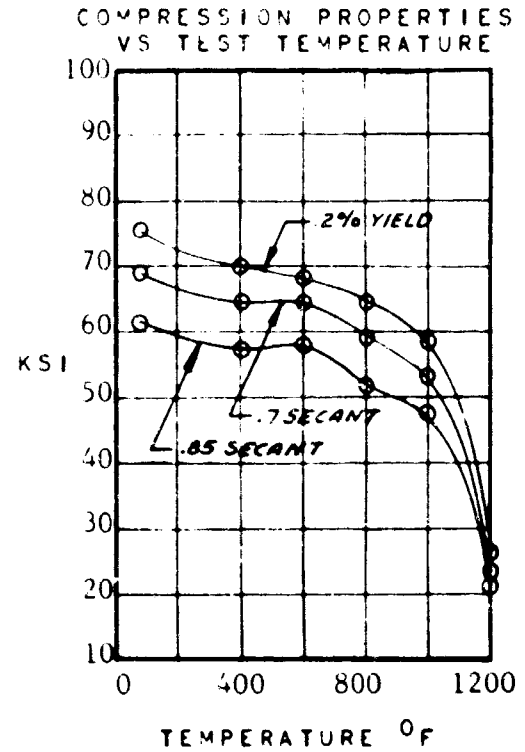


FIGURE 3

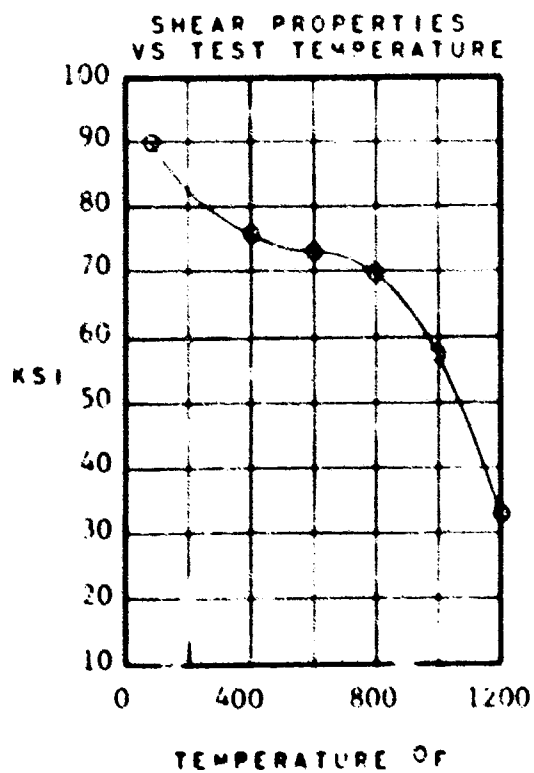
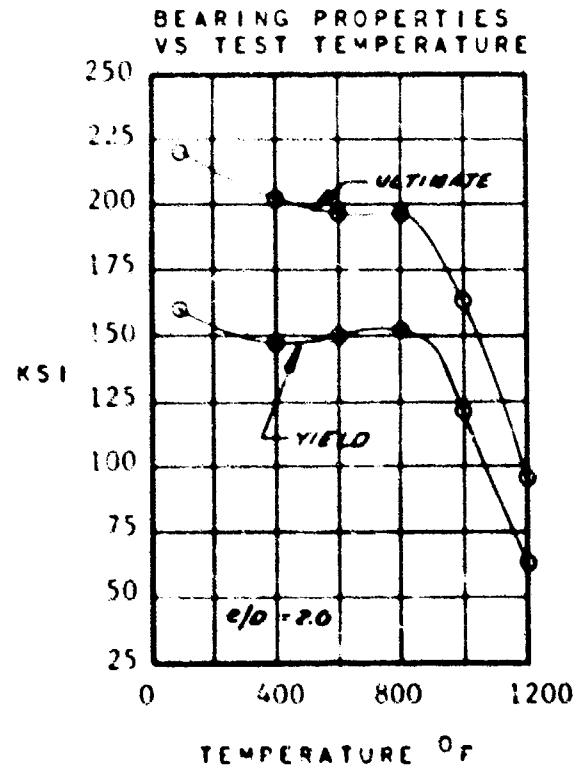


FIGURE 4



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FIGURE 5

CREEP DEFORMATION VS TIME.
TESTED AT 600°F AND INDICATED STRESSES.

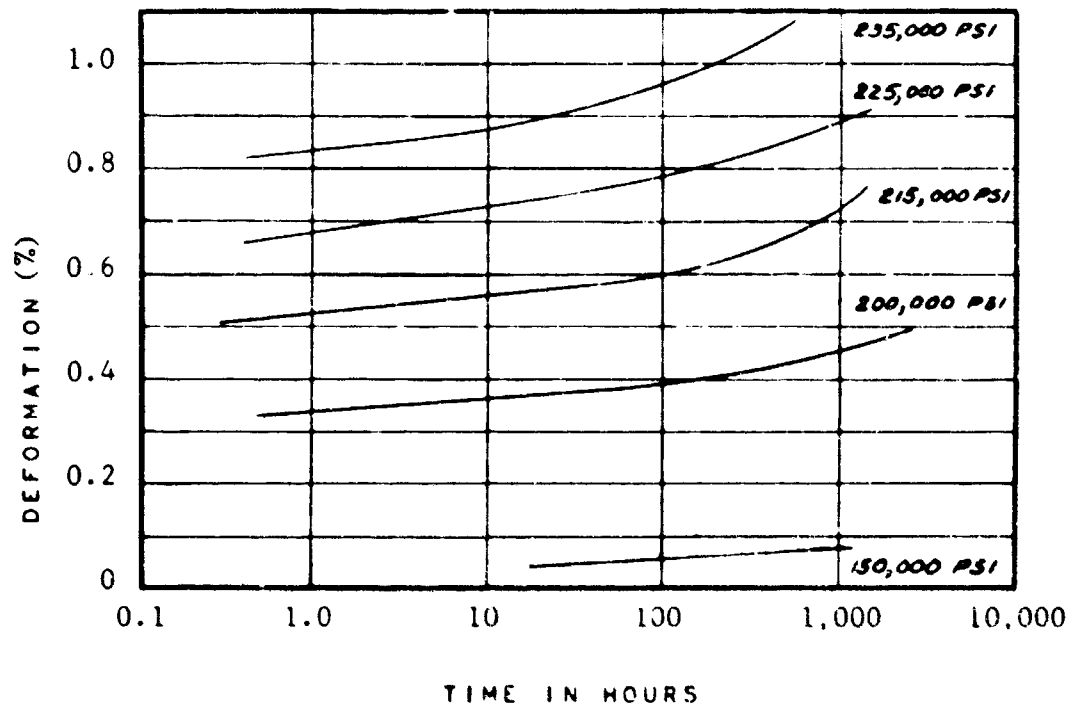
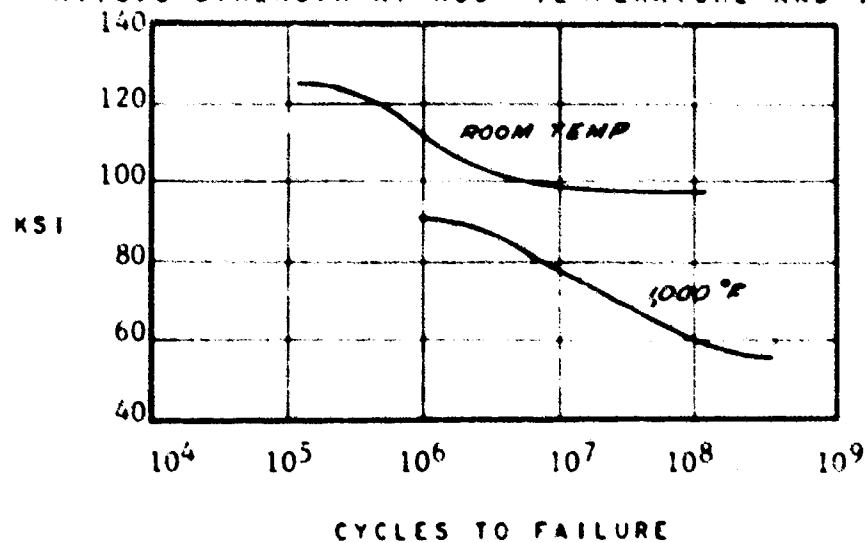


FIGURE 6

FATIGUE STRENGTH AT ROOM TEMPERATURE AND 1000°F



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REFERENCE LIST

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